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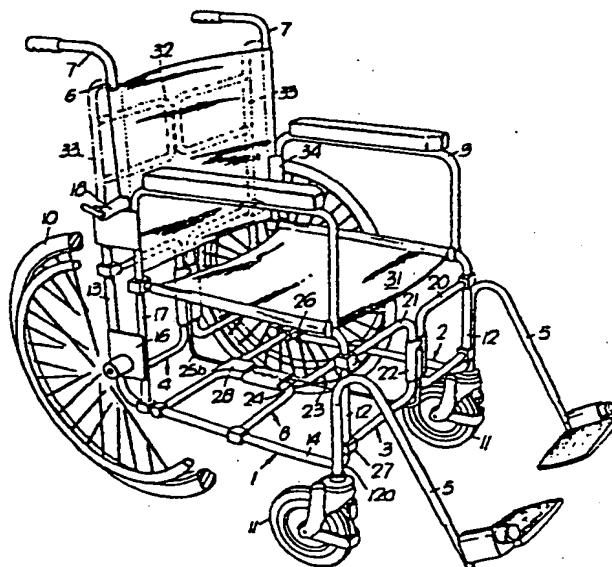
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(54) Folding wheelchair.

(57) A folding wheelchair has side frame (1 and 2) connected by front, rear and bottom toggle braces (3, 4 and 5) which in the folded position permit the side frames to come together. Each toggle brace is preferably formed from a pair of U-shaped elements (20, 21) hingeably connected at the base of the U, the toggle braces co-operating with the framework such that folding is initiated by lifting upwardly of the bottom toggle brace (8). This is best achieved by a rigid rod (23) linking the front and rear toggle braces (3 and 4) and carrying abutment means (24) for engaging with the bottom toggle brace (8) so that folding of the front and rear toggle braces (3 and 4) cannot occur until the bottom toggle brace (8) is lifted. The wheelchair may have at least one toggle brace of U-shaped members with the base of each U divided transversely to provide for relative rotational motion between the portions of each U-shaped member. The wheelchair may also have a novel folding footrest (40 to 47).

Fig. 1



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"FOLDING WHEELCHAIR"

The present invention relates to folding wheelchairs and more particularly is concerned with a folding wheelchair having side frames mounted on wheels with a folding seat extending between the side frames and toggle brace assemblies pivotally connected to and extending between the side frames for bracing the side frames apart when the wheelchair is in use but folding to permit the wheelchair to be collapsed.

In the past folding wheelchairs have commonly been constructed with a seat supported on a framework which has scissor-like bracing permitting the chair to be collapsed so that the vertical sides come towards one another. However, generally such wheelchairs have been heavy and relatively bulky thus presenting problems in loading the wheelchair into a vehicle.

Desirably, a folding wheelchair should be folded readily into a very compact space so that it can be loaded into a small car and furthermore it should be relatively lightweight to permit easy handling of the chair. However, the wheelchair must be strong and durable since wheelchairs are

5 subjected to considerable stresses particularly  
when the user jumps over gutters or plays sports  
such as wheel-chair basketball. It is also important  
that a wheelchair can be quickly and easily be  
folded, for example by a handicapped person after  
he has transferred himself to the seat of a vehicle.

10 In this specification the expression "wheelchair"  
is used not only to cover wheelchairs for invalids  
but also to cover other forms of wheeled carriages  
including various forms of baby carriage. Although  
a major and important application of the present  
invention is to wheelchairs for invalids and  
handicapped persons, the invention may also find  
other applications.

15 One of the most important design factors for a  
folding wheelchair is the thickness of the unit  
when folded. Indeed even a small decrease in the  
thickness of a folded chair can be extremely  
valuable in permitting the chair to be loaded into  
20 and stored in cars, particularly small cars. Much  
of the thickness is taken up by main rear wheels  
which when each rear wheel has a rigid hand rim  
results in each wheel requiring several inches of  
thickness. Wheelchairs hitherto available have  
25 had, at best, an overall thickness of about 10"  
when folded and furthermore have had the severe  
disadvantage of being relatively heavy, for example  
of the order of 50 lbs. or more.

30 The present inventor has proposed a useful  
alternative to wheelchairs hitherto on the market  
in his U.S. Patent 3758150 but it is considered  
that still further improvements and modifications  
would be desirable.

35 The present invention is concerned with providing  
an improved foldable framework for a wheelchair,

the framework being capable of being folded so as to be relatively thin and the design of the framework being such that it may be constructed so as to be relatively light in weight yet still  
5 durable.

According to a first inventive development, there is provided a folding framework for the wheelchair with the toggle brace assemblies in the form of front, rear and bottom toggle brace assemblies which  
10 are pivotally connected to and extend between front, rear and bottom portions of the side frames and are foldable between a bracing position in which the side frames are held apart and a folded position in which the side frames can be adjacent  
15 to one another. One inventive aspect in such a wheelchair is further characterised by the provision of holding means mounted in co-operating relationship with the bottom toggle brace assembly for urging the front and rear toggle brace assemblies into  
20 their bracing positions until the bottom toggle brace assembly is lifted towards its folded position.

According to a further inventive feature, at least the front toggle brace assembly can be in the form of a pair of U-shaped elements pivotally  
25 interconnected by a hinge at the base of the U and a folding footrest assembly pivotally mounted on each U-shaped element and foldable within the U-shaped element prior to folding of the wheelchair.

According to yet another inventive feature at  
30 least one of the toggle brace assemblies is formed from a pair of U-shaped elements pivotally interconnected through a hinge at the base of the U with the free end portions of the legs of each U-shaped element connected pivotally over a rail of the side  
35 frame of the wheelchair and the base of each U-shaped element being transversely divided to form

two base portions which are mounted within a sleeve of the hinge so as to be rotatable relative to one another so as to permit flexing of the wheelchair when in use.

5           In a preferred and important embodiment of the invention, the holding means is in the form of a rigid pivotal link pivotally connected to the front and rear toggle brace assemblies which fold rearwardly.

10           Furthermore, the best manner of ensuring that the front and rear toggle brace assemblies do not commence to fold until the bottom toggle brace assembly has been lifted is to provide an abutment element projecting upwardly from the rigid link for engagement with a front portion of the bottom  
15 toggle brace assembly.

          The best manner of ensuring easy and reliable folding of the front and rear toggle brace assemblies is to provide a cam-like striker element projecting upwardly and forwardly from a rear portion of the  
20 rigid link so as to be engaged and displaced by the bottom toggle brace assembly as it is lifted.

          A convenient remote lifting device for the bottom toggle brace assembly can be provided and indeed this feature can also ensure positive  
25 locking of the bottom toggle brace assembly even though positive locking is not essential providing the framework is manufactured in a sound manner. Most preferably the remote lifting device is provided by an operating rod pivotally linked to a  
30 central region of the bottom toggle brace assembly and extending upwardly to a suitable connection point. The top of the operating rod can be attached to a folding seat of the wheelchair so that the folding seat is simply pulled upwards towards the  
35 folded position thereby pulling upwardly the operating

rod. When in use, however, the weight of the user of the seat urges downwardly the operating rod thereby positively locking the framework in the erected position.

5           In this specification the term "toggle brace" is used to refer to any form of brace having two pivotally connected arms which tend to remain in a braced condition when extended. Frameworks embodying the present invention preferably have toggle brace  
10 assemblies comprising a pair of U-shaped bracing arms but this is not essential; furthermore it is not essential for the bracing arms to go "over centre" to the bracing position.

Advantageously a further brace, preferably a  
15 toggle brace, is mounted at a position spaced behind the position for the backrest of the framework thereby provided extra strengthening of the framework.

For the purposes of illustration only, an  
20 embodiment of the invention will now be described with reference to the accompanying drawings of which:

Figure 1 is a perspective view of an embodiment of the invention;

25           Figure 2 is a schematic side elevation showing the wheelchair of Figure 1 in a folded condition;

Figure 3 is a view on an enlarged scale illustrating an optional alternative footrest arrangement;

Figure 4 is a view on an enlarged scale  
30 showing the footrest of Figure 2 when in the folded condition.

Figure 5 is a view on an enlarged scale showing the a preferred form of hinge for each toggle brace; and

35           Figure 6 is an end view of one of the sleeve-

like hinge elements for the hinge of Figure 5.

Referring first to Figure 1, the collapsible folding wheelchair is formed from side frames 1 and 2, front and rear toggle braces 3 and 4, removable footrest units 5, foldable side frame extensions 6 each having a handle 7, a bottom toggle brace 8, detachable arm rests 9, two large rear wheels 10, and small front castor wheels 11.

Each side frame 1 and 2 consists of a generally rectangular tubular metal frame work formed from front and rear vertical tubes 12 and 13 and upper and lower horizontal tubes 15 and 14. Each castor wheel 11 is mounted in a small tube 12a attached to the vertical tube 12, the footrest telescopically engaging in the top of the tube 12a. Each rear wheel 10 is mounted on an axle attached to a bracket 16 which spans between the vertical tube 13 and an auxiliary back tube 17, this providing a lightweight but strong and durable structure.

At a position above the seat height, each of the upstanding side extensions 6 is articulated and secured in position by a clamp 18.

Each of the toggle braces 3, 4 and 8 are similar and only the front toggle brace will be described in detail. The front toggle brace 3 comprises a pair of U-shaped members 20, 21 with the legs of each U extending horizontally and the free ends pivotally connected to the associated vertical tube 12 by a pivotal mounting block 27, a preferred form of which is described below with reference to Figure 5. Collar-like stops such as stop 26 shown in the lower rail 14 can limit movement of the toggle brace along the axis of the rail to which it is attached. A sleeve-like hinge 22 connects the U-shaped members at the base of the

U. further details being described below with reference to Figures 5 and 6.

For the purpose of (a) providing rigidity in the wheelchair when erected, and (b) facilitating erection and collapsing in a reliable manner and (c) ensuring that no folding of the wheelchair occurs in the event that the front toggle brace 3 receives a kick, a rigid link 23 extends below the bottom toggle brace 8, the rigid link being pivotally connected to the front and rear toggle braces by the upturned ends 25a and 25b of the rigid link being pivotally engaged in respective mounting tubes 22a fixed to the associated hinges of the toggle braces. The rigid link 23 in its central portion has an upwardly projecting abutment stop 24 and a striker element 28. In the erected condition shown in Figure 1, the rear edge of the abutment element 24 is adjacent the front end of the hinge at the bottom toggle brace 8 thereby preventing either of the rear or front toggle braces being folded until the bottom toggle brace 8 is first lifted. The striker plate 28 has a cam-like nose disposed so that when the bottom toggle brace 8 is lifted, after a small amount of motion sufficient for the hinge to clear the abutment stop 24, the rear of the hinge of the bottom toggle brace displaces the striker plate 28 rearwardly thereby initiating closure of the front and rear toggle braces.

Folding of the wheelchair and also reliable retention of the framework in an erect condition is facilitated by an operating rod 29 for convenience shown only in Figure 2 in dotted lines. The bottom end of the operating rod is pivotally connected to the rear central region of the bottom toggle



brace 8, the operating rod 29 extending upwardly to a connection portion 30 which in one embodiment is simply attached to the foldable fabric seat 31.

To collapse the wheelchair, the fabric seat is simply gripped and pulled upwardly thereby pulling the operating rod 30 which lifts the rear toggle brace and by virtue of engagement with the striker plate 28 all the toggle braces collapse simultaneously. When the chair is in use, the weight of the user urges the operating rod 29 downwardly thereby holding down the bottom toggle brace 8.

Figure 1 shows a further optional feature, namely a fourth toggle brace 32 of similar form attached to auxiliary side tubes 33. This toggle brace folds rearwardly and in the erected condition moves "over centre" to brace the back of the wheelchair. This toggle brace must be released first before the chair can be folded.

The armrests 9 are readily removable with a rear tube of the armrest telescopically engaging in an tube 34 and the front tube of the armrest engaging over the front of the side rail 15.

Referring now to Figures 3 and 4, an alternative footrest is illustrated. This type of footrest can fold entirely within the U-shaped element 20 or 21 of the front toggle brace 3 and is pivotally connected thereto. Furthermore this style of footrest can positively locate the foot of a handicapped person.

The footrest of Figures 3 and 4 comprises a foot plate 40 having side flanges which is pivotally mounted on a bottom bracket 41 with limited rotational movement, the bottom bracket 41 being telescopically engageable within the tubes of an upper bracket 42 having top cross tubes 43 pivotally engaged on the

lower horizontal leg of the toggle brace 3. Apertures 44 are provided so as to permit adjustment of the footrest, a fixing pin being inserted through a pair of aligned apertures at a selected position.

5           A pair of side stays 45 are provided but only one of these stays is shown in Figure 3. Each stay has upper and lower arms pivotally joined, the lower arm being pivotally connected by a pivot pin 46 to the arm 41 and the upper arm being pivotally  
10           mounted by a mounting block 47 to the upper horizontal leg of the U-shaped toggle brace.

          Referring now to Figures 5 and 6, details of a preferred embodiment of hinge connection 22 are shown. In this case the hinge 22 is fabricated  
15           from a pair of corresponding mouldings shown in end view in Figure 6 and adapted to be snap fitted over the base portion of the associated U-shaped element 20 or 21. A hinge pin 50 is securely positioned to  
20           complete the hinge.

          In order to absorb stresses resulting from the wheelchair passing over rough ground, limited articulation between the respective arms of each U-shaped element is possible since the base of each U is divided as shown in Figure 5. One of the base  
25           portions only may be attached positively to the hinge by a rivet 51.

          Furthermore there is preferably provision for rotation between each leg of a U-shaped element and its associated mounted block 27. This can be  
30           conveniently achieved as shown in Figure 5 by providing an annular groove 52 near the end of the leg of the U-shaped element and centre punching at 53 the exterior of the mounting block 27.

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## CLAIMS. :

1. A folding wheelchair comprising first and second side frames (1 and 2) mounted on wheels (10,11), a folding seat (31) extending between the side frames, and toggle brace assemblies (3, 4 and 8) pivotally connected to and extending between the side frames characterised by the toggle brace assemblies comprising front, rear and bottom toggle brace assemblies respectively mounted between front, rear and bottom portions of the side frames (1 and 2), each toggle brace assembly (3, 4 and 8) being foldable between a bracing position in which the side frames (1 and 2) are held apart and a folded position in which the side frames move adjacent to one another, and the wheelchair further comprising holding means (23, 24, 25) adapted to co-operate with the bottom toggle brace assembly (8) when in the bracing position to hold the front and rear toggle brace assemblies (3 and 4) against folding until commencement of folding of the bottom toggle brace assembly (8).

25

2. A wheelchair according to Claim 1 wherein the front and bottom toggle brace assemblies (3 and 8) are dimensioned and connected to fold and, in the folded position, lie within the side frames, and the rear toggle brace assembly (4) folds rearwardly of the side frames (1 and 2).

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3. A wheelchair according to Claim 2 wherein the holding means comprises a rigid link (23) pivotally connected at its end portions (25a and 25b) to

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central portions of the front and rear toggle brace assemblies (3 and 4) for pivotal motion about vertical axes, the rigid link (23) extending below the bottom toggle brace assembly (8).

4. A wheelchair according to Claim 3 wherein the rigid link (23) has an upward projection (24) providing an abutment surface for engaging a front portion of the bottom toggle brace assembly (8) when the wheelchair is in the bracing position.

15 5. A wheelchair according to Claim 3 or Claim 4, wherein the rigid link (23) includes a striker element (28) extending upwardly at a location adjacent to the rear of the bottom toggle brace assembly (8) when the wheelchair is in the bracing  
20 position, the striker element (28) projecting forwardly to provide a cam surface co-operating with the bottom toggle brace assembly (8) which strikes the cam surface when folding commences thereby urging rearwardly the rigid link (23).

25 6. A wheelchair according to any one of Claims 1 to 5 and further comprising an operating rod (29) pivotally connected and extending upwardly from a  
30 central region of the bottom toggle brace assembly (8), means (31) for urging downwardly the operating rod when the wheelchair is in use, the operating rod being manually upwardly retractable to initiate folding of the wheelchair.

35

7. A wheelchair according to Claim 6 wherein the means for urging downwardly the operating rod (29) comprises the folding seat (31) of the wheelchair, the operating rod being connected to a rear central portion of the seat.

8. A wheelchair according to any one of Claims 1 to 7 wherein at least one of said toggle brace assemblies (3, 4 and 8) in the bracing position is substantially in a dead centre position.

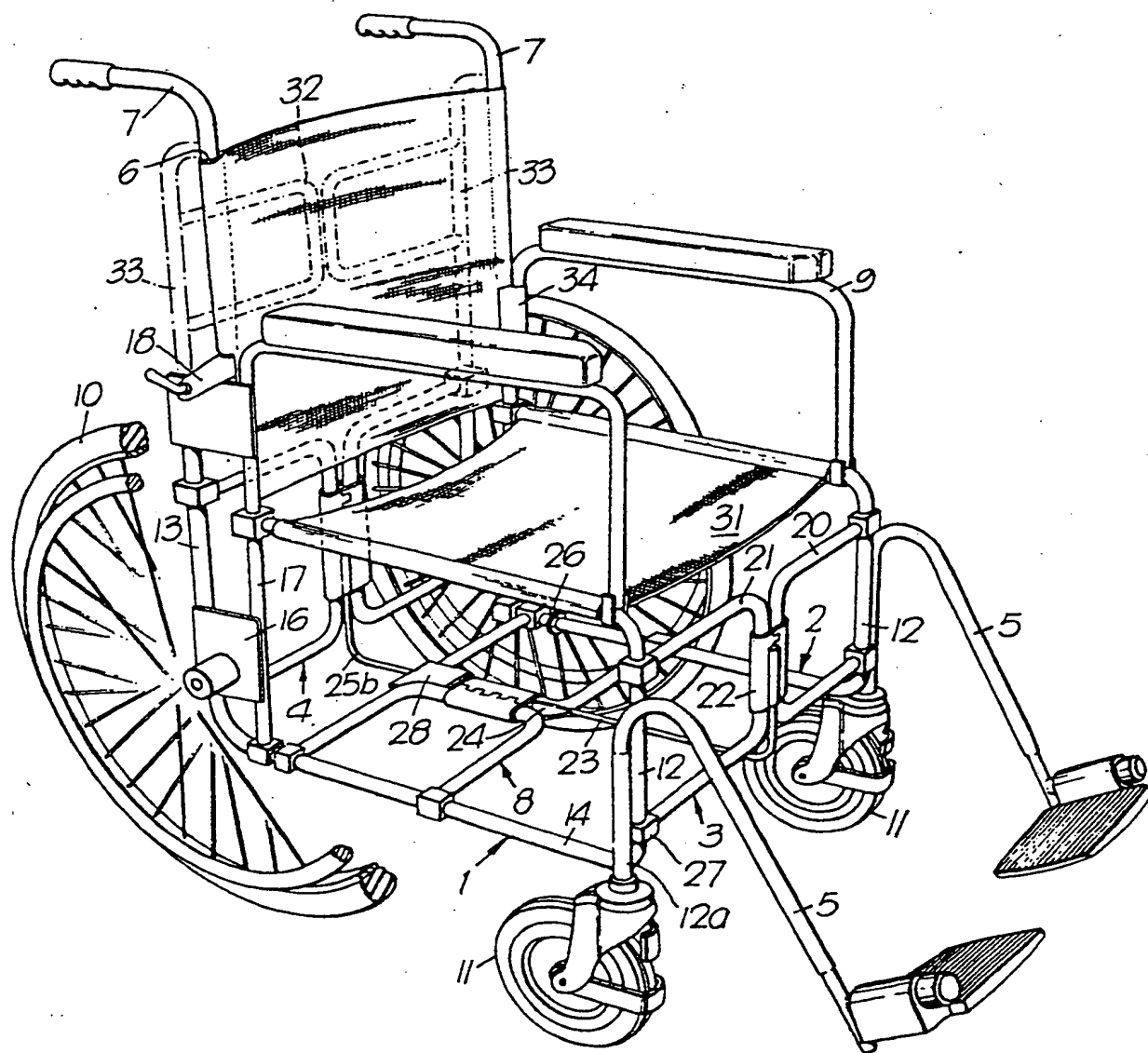
9. A wheelchair according to any one of Claims 1 to 8 wherein each side frame (1 and 2) has rear leg work comprising a pair of substantially parallel spaced tubes (13, 17 and 33) at the upper end of which a handle (7) is provided, an upper portion of the forward tube (17) mounting a fabric backrest and an upper portion of the rear tube (33) mounting a toggle brace adapted to fold rearwardly.

10. A wheelchair according to any one of Claims 1 to 9 wherein the front toggle brace assembly (3) comprises a pair of U-shaped tubes (20, 21) with the base portions of the U's connected at a hinge (22) and the end portions (27) of the legs being pivotally connected to front legs (12) of the side frames (1 and 2), and a foldable footrest (40 to 47) is pivotally mounted and foldable within each of the U-shaped tubes (20 and 21).

11. A wheelchair as claimed in any one of Claims 1 to 10, wherein each toggle brace assembly (3, 4 and

6) is formed from a pair of U-shaped elements (20, 21) the free ends (27) of the legs of each U-shaped element being attached to the side frames (1 and 2) by a pivotal connection and each pair of U-shaped elements being connected by a hinge (22) of sleeve-like form through which the base of each U-shaped element passes, each U-shaped element being divided transversely in the central portion of the base of the U whereby relative rotational movement of the portions of the base of the U can occur.

12. A wheelchair according to Claim 11 wherein each leg of each U-shaped element (20, 21) has a T-shaped end piece (27) through which a rail (12, 13, 14 and 15) passes, the end piece (27) being pivotally interconnected with corresponding leg for relative rotational movement about the axis of the leg, stop means (26) being provided on the rail or limiting axial movement of the end piece (27) along the rail.

*Fig. 1.*

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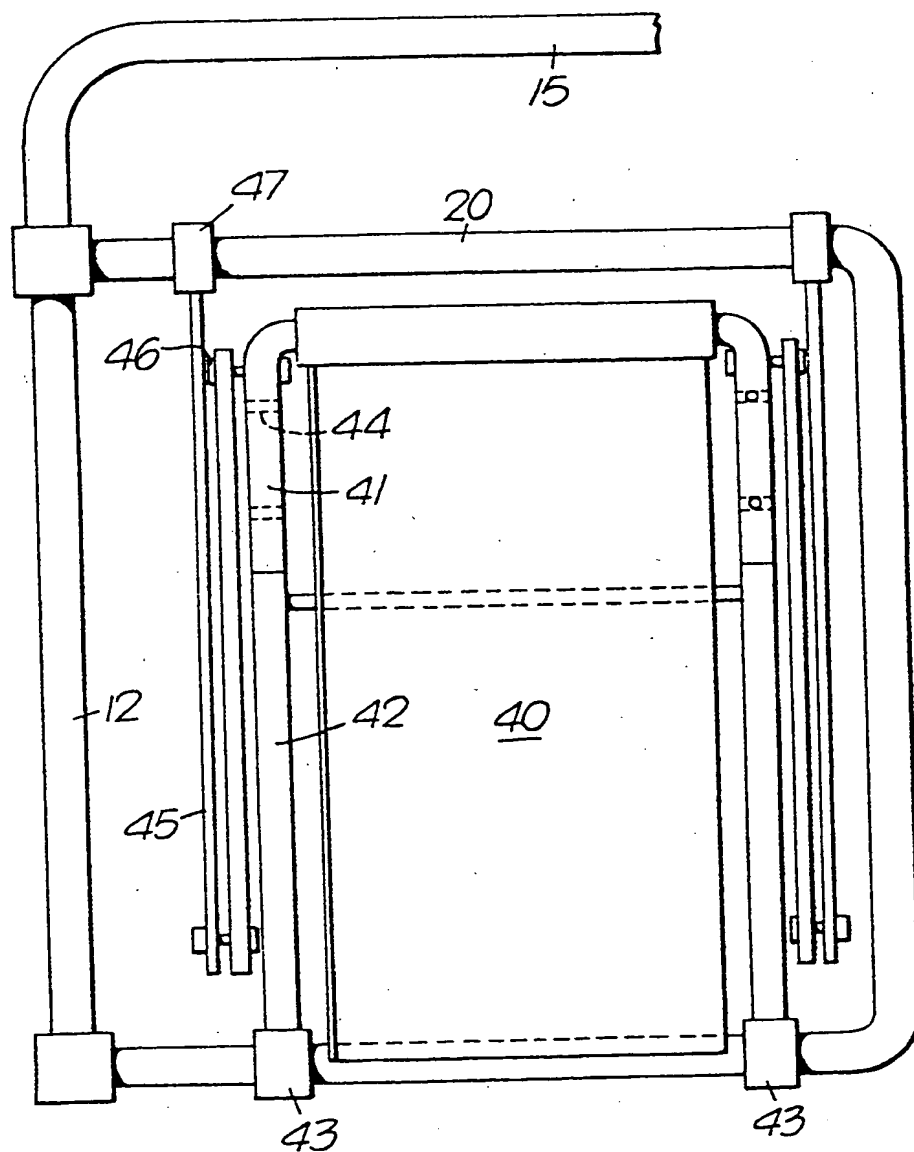
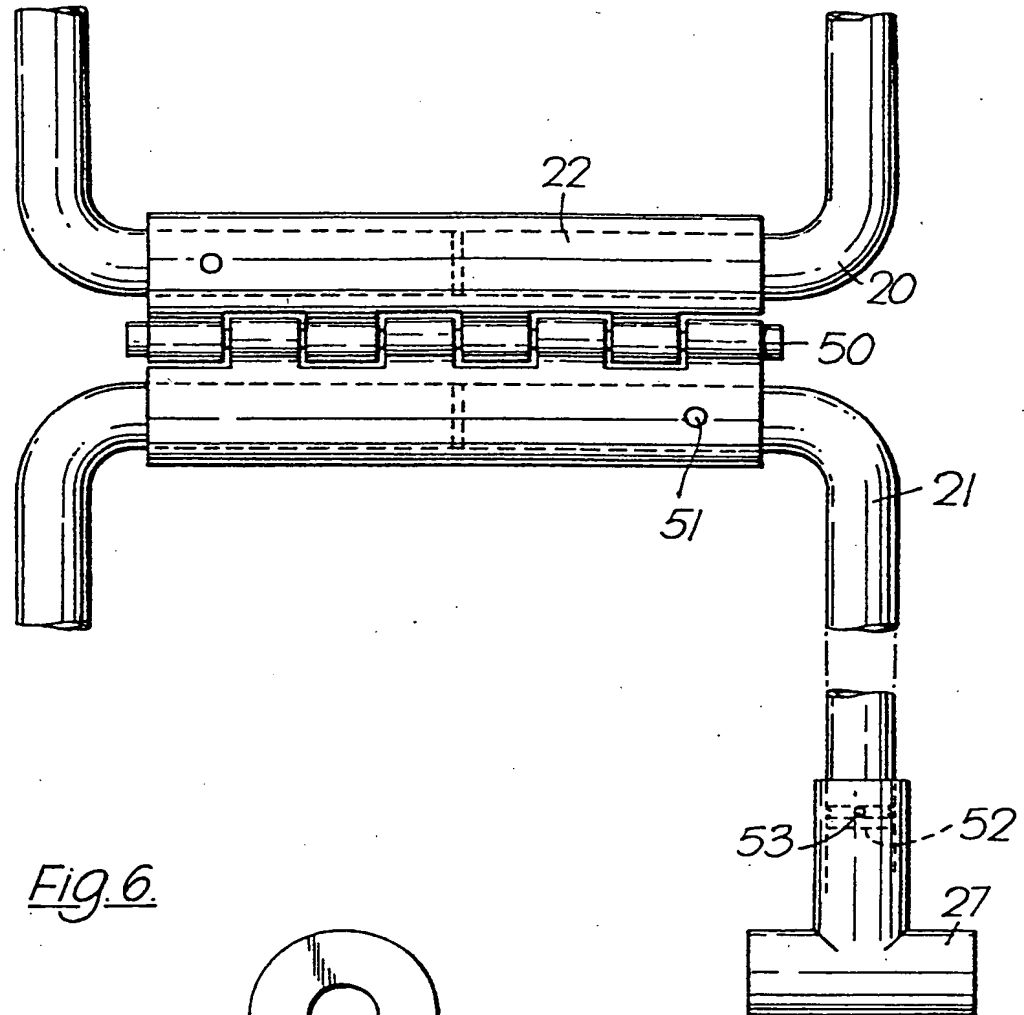
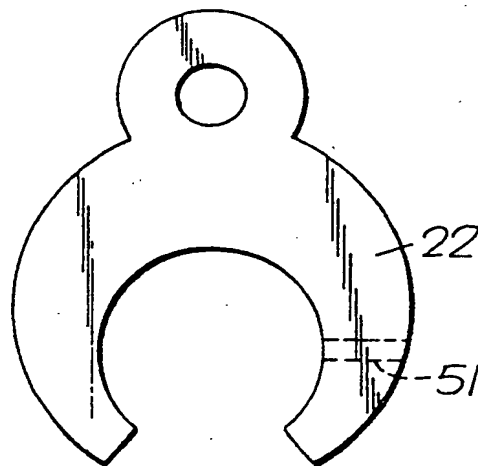
Fig. 4.

Fig. 5.Fig. 6.

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# EUROPEAN SEARCH REPORT

Application number

EP 79 30 0403

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl. <sup>3</sup> )
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
	<u>US - A - 3 142 351</u> (G. GREEN) * Figures 1-6; column 2, line 57 - column 4, line 9 * --	1-3,6 7,11, 12	A 61 G 5/00
	<u>US - A - 2 782 870</u> (G. SILL) * Figure 1; column 1, line 66 - column 2, line 5; column 2, lines 42-62 * --	1,2,6, 7	
	<u>DE - B - 1 176 315</u> (G. SCHLADEBACH) * Text and figures * --	1-4	TECHNICAL FIELDS SEARCHED (Int.Cl. <sup>2</sup> )  A 61 G
D	<u>US - A - 3 758 150</u> (P. WILLIAMS) * The figures; column 2, lines 7-11; 30-52; column 2, line 63 - column 3, line 9 * -----	1,2, 9-12	
			CATEGORY OF CITED DOCUMENTS X: particularly relevant A: technological background O: non-written disclosure P: intermediate document T: theory or principle underlying the invention E: conflicting application D: document cited in the application L: citation for other reasons
The present search report has been drawn up for all claims			&: member of the same patent family, corresponding document
Place of search	Date of completion of the search	Examiner	
The Hague	27-06-1979	VEREECKE	